

# DuPont™ GenX Processing Aid for Making Fluoropolymer Resins

SETTING A NEW INDUSTRY STANDARD FOR  
SUSTAINABLE REPLACEMENT TECHNOLOGY



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## Introduction



DuPont has achieved a significant milestone in meeting our commitment to no longer make, buy or use perfluorooctanoic acid (PFOA) by 2015, or earlier if possible. DuPont has developed patented GenX technology for a new-generation processing aid that enables us to make high-performance fluoropolymers without the use of PFOA.

As described further below, DuPont™ GenX technology is a more sustainable solution that includes a new processing aid with a favorable toxicological profile and very rapid bioelimination, combined with unique environmental exposure control technologies that reduce the potential for environmental release and exposure.

GenX technology also enables the production of fluoropolymer resins, and end-use articles made from the resins, that contain extremely low to non-detectable residual processing aid content.

DuPont began in 2009 to convert customers to the use of fluoropolymers made with our alternative technology, which enables DuPont and our customers to continue to meet exacting end-use requirements.



## Fluoropolymer Resins in Critical Applications



Fluoropolymer resins and finished goods play a vital role in many critical applications due to their unique physical properties such as resistance to high and low temperature, resistance to chemical and environmental attack, non-stick characteristics, and dielectric and fire-resistant properties that are needed in a wide range of electrical and electronic applications.

Fluoropolymer-based materials are critically important in providing cable and internet service, generating clean and renewable energy, and manufacturing more efficient and reliable vehicles. They are vital for a clean and safe food supply, and for making insulation for cabling that is essential for safety, security and performance in buildings, data centers, ships and aircraft.

Fluoropolymers are used to manufacture non-stick coatings for cookware, and breathable, water-repellent garments for outdoor, military, medical and clean room activities. Without fluoropolymers we would not have lightweight, compact and affordable laptops, cell phones, media players and home theaters as we know them today.



## DuPont™ GenX Processing Aid Technology

Our new GenX Processing Aid Technology package includes:

1. Exposure control technologies with state-of-the-art efficiencies;
2. Extremely low or no extractable water-soluble residuals in finished polymers and end-use articles;
3. Processing aid with favorable toxicological profile and very rapid bioelimination.

## GenX Processing Aid

GenX technology includes a new processing aid, which is used only for fluoropolymer resin manufacturing. It has the following chemical structure:  $\text{CF}_3\text{CF}_2\text{CF}_2\text{OCF}(\text{CF}_3)\text{COOH.NH}_3$

The processing aid was reviewed by the U.S. Environmental Protection Agency (EPA) through the Premanufacture Notification Process.

## Exposure Control Strategy

The new processing aid is chemically stable and, if released, would be environmentally persistent. To address this, the goal of the DuPont™ GenX exposure control strategy is to contain the new processing aid within the manufacturing site and to minimize worker exposures. This strategy utilizes various combinations of environmental engineering controls which work both individually and collectively to minimize releases and exposures.

The environmental engineering controls include:

Filters and Scrubbers	Carbon Canisters	Thermal Converters
Deep-Bed Scrubbers	Autoclaves	Extruders & Pelletizers
Carbon Beds	Oven Dryers	Emissions Monitoring

Through this system, the processing aid is recovered and/or recycled, or it can also be captured and converted to calcium fluoride (CAS Number 7789-75-5), which is the original, naturally occurring mineral used as a starting point to make fluoroproducts.

## Extremely Low or No Extractable Water-Soluble Residuals

GenX technology enables the production of fluoropolymer resins that contain extremely low or non-detectable processing aid content. After the GenX processing aid is used in fluoropolymer resin production, extractable processing aid residue can be thermally transformed into a hydride. The hydride is water-insoluble, which reduces or eliminates its potential to move into the environment via water.

## Favorable Toxicological Profile

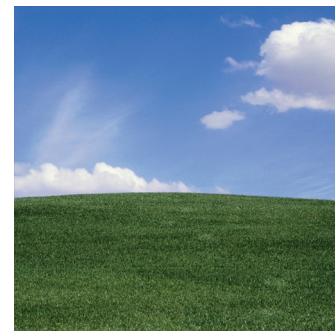
### Very rapid bioelimination

The DuPont™ GenX processing aid offers very rapid bioelimination in pharmacokinetic studies, and therefore has a very low potential for accumulation in the body. Virtually complete elimination from the body occurs in 12-24 hours in laboratory animals, compared with months for PFOA elimination.

### Toxicological Profile

The DuPont™ GenX processing aid possesses low acute toxicity in mammalian and aquatic testing; low repeated dose toxicity in mammalian testing; is not mutagenic nor genotoxic; and is not a skin sensitizer. Some eye and skin irritation can occur when coming in contact with the GenX processing aid. In repeated dose studies in rodents, effects were mostly limited to liver-related changes that are due to a mechanism generally not considered to be relevant to adverse effects in humans. In addition, a slight decrease in gestation length and lower birth weights were observed in a rat study only at very high doses, thousands of times higher than any potential human exposure.

Toxicological studies such as these are designed to find effects, through the use of intentionally high doses, in order to establish exposure limits with wide margins of safety. Additional studies of this processing aid are being conducted, and results will be available over the next several years.



DuPont resin manufacturing process includes the thermal transformation of the GenX processing aid into a hydrophobic water-insoluble hydride (CAS Number 3330-15-2). This hydride is listed on the U.S. EPA Toxic Substances Control Act (TSCA) inventory and has extremely low acute toxicity, as well as low toxicity in repeat-dose two-week inhalation studies. The hydride also has low-to-no bioavailability and is neither mutagenic nor genotoxic.

## U.S. EPA TSCA Office Approves Polymerization Aid for Commercial Activity

U.S. EPA, through a Toxic Substances Control Act (TSCA) Section 5(e) Consent Order, granted DuPont approval, under conditions set forth in the Order, to commercially manufacture, process and distribute the polymerization aid. Under the Order, DuPont has agreed to operate with 99 percent or greater overall environmental control efficiency with the GenX processing aid. Additionally, DuPont intends to demonstrate that extractable residual processing aid content in fluoropolymer resins is less than 200 parts per billion using the method prescribed by the U.S. EPA.

## DuPont Received Positive Opinions for Food Contact Applications

DuPont has received positive opinions from the European Food Safety Authority (EFSA) and the Dutch Safety Review Committee (G4) / Dutch National Institute for Public Health and the Environment (RIVM) to use the GenX processing aid as a permitted substance in food contact applications. DuPont has also received third-party confirmation from Keller and Heckman, LLP that the GenX processing aid complies with food contact requirements of the U.S. Food & Drug Administration (FDA).

## Customer Conversion to DuPont™ Fluoropolymers Using GenX Processing Aid Technology

We began in 2009 to convert customers to the use of fluoropolymers made with our alternative technology. We will phase out in stages and will be completed by 2015, or earlier if possible. Products made using GenX technology are being formulated and commercialized based on market segment. Timelines will vary by product line.

## DuPont, Sustainability, and Core Values

The need for truly sustainable options for 21st century life remains one of the most critical challenges facing the global community. As a society we need to find ways to encourage innovation in ways that drive energy and resource efficiency, reduce greenhouse gas emissions, develop a more sustainable infrastructure and encourage job creation.

As a science company, DuPont has the experience and expertise to put our science to work in ways that can design in – at the early stages of product development – attributes that can deliver solutions that help protect or enhance human health, safety and the environment. Through our science, we will design products and processes that pass rigorous criteria for reducing the use of energy, water and materials and encourage the development of products based on the use of renewable resources. We believe this is a direct route to a successful, profitable business that adds value for our customers, their customers, consumers, and the planet.

## Summary and Conclusions

DuPont™ Fluoropolymers using the new GenX technology will enable customers worldwide to provide products with high societal value. DuPont continues to lead the polymer industry by putting our scientific expertise to work to develop more sustainable products.

The new DuPont™ GenX technology offers a favorable toxicological profile and very rapid bioelimination, combined with a manufacturing control system to minimize the potential for environmental releases and resulting exposures. The processing aid possesses low acute toxicity in mammalian and aquatic testing, is not mutagenic or genotoxic, and is not a skin sensitizer.

The GenX technology also enables the production of fluoropolymer resins, and end use articles, that contain extremely low to non-detectable residual processing aid content.

U.S. EPA and DuPont entered into a TSCA Consent Order allowing DuPont to commercially manufacture and use the new polymerization aid under conditions set forth in the Order.

[www.genx.dupont.com](http://www.genx.dupont.com)

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